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Statistical analysis of the behavior for mobile E-learning

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Abstract

Evolution of mobile devices has led to the development of Mobile E-Learning. E-Learning platforms have been developed to be accessed from personal computers. Now the question is how to organize the content so that it can be accessed from mobile devices. To solve this problem is required a statistical analysis on accessing e-learning platforms on mobile devices. It was developed E-Learning platform with automated data collection and information on how it is accessed by the users. The application has been provided for testing to the students. Based on data obtained automatically building statistical analyzes highlight trends of use of Mobile E-Learning environment.

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Keywords: Mobile; E-Learning; Statistical Analysis; Web Application; Development

1. Introduction

Mobile devices have been rapidly evolving in recent years, reaching from simple MotoralaDynaTAC 8000X mobile phone launched by Motorola in 1973 used just for making calls to smartphones used today in all activities especially at internet browsing. In (Zamfiroiu and Despa, 2013) is provided the evolution of the number of mobile devices sold in the 1992-2012 period. This was possible due to the evolution of hardware features that are built mobile devices. A major role in mobile devices components is the processor. Frequency of the processors used in mobile devices is lower than the operating frequency of processors available on personal computers due to the need of low power consumption. Output unit for all mobile devices is represented by the screen. Input devices are diversified:

- numeric keypad;

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- QWERTY keyboard;
- HALF-QWERTY keyboard;
- touch screen;
- mini-Joistick.
- Modern mobile devices include sensors for applications such as:
- accelerometer;
- GPS receiver;
- camera;
- ambient sensor;
- proximity sensor;
- magnetic sensor.

Sensors that the mobile devices are equipped contribute to the use of mobile in all areas of life. Such applications are developed using these sensors and create the simple mobile phone gadget in a real 'hands.

2. Mobile e-learning

E-Learning Platforms and Web-based applications have been very popular allowing users to access information via internet directly experience on the personal computers. M-Learning or Mobile E-Learning allows access to information via the Internet through mobile devices. In the M-Learning environment, courses or platform are customized for each user. Customization is done in the following steps:

- modeling user profile;
- acquiring information about the user;
- generating personalized services.

In (Lee and Saiman, 2012) the term of M-Learning is defined as the Science in hand and includes the use of mobile devices for obtaining performance in education. Any type of device has the ability to fulfill the functions of M-learning such as educational course delivery, the possibility of communication between students and teachers, presentation evaluations, providing access to course materials.

According to (Ghazvini, Earnshaw et al., 2011) M-Learning is an educational paradigm that is more flexible than traditional E-Learning or learning. Mobile devices are cheaper than personal computers and so are bought by many people. Users take these devices all the time from them because they are small, portable and easy to carry. Learning is facilitated by combining different types of resources and different ways to increase the knowledge and skills. The information in the courses are available in the games form. Games are played on mobile devices often whenever even a walk in the park or on the street. Thus the user appropriates information during other activities.

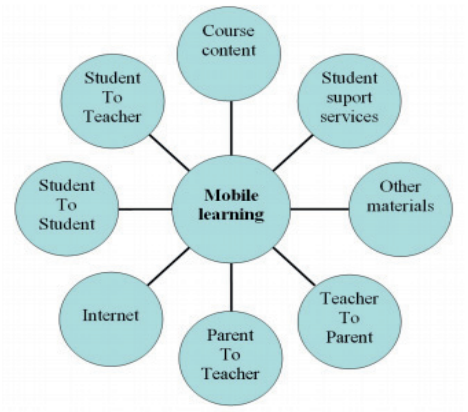

Fig. 1. M-Learning Environment

In (Vucetic and Odadzic, 2010) Mobile School Service - MSS project, illustrated in Figure 1, is described. The mobile application provides a simplistic interface due to restrictions on mobile devices:

- small size of the display, as are devices pocket dimensions are reduced;
- low capacity of data entry, data entry opportunities are represented by small alphanumeric keypad or QWERTY keyboard whose keys have small;
- low power computing due to the energy consumption;
- low capacity memory.

In (Charland and LeRoux, 2011) skills to be considered for programming applications for mobile devices for different platforms are presented. Thus for application development for multiple platforms development company is required to hire more programmers with skills for some platforms or programmers with skills for all platforms, but it is quite hard to find a person who excels in developing mobile applications for all platforms.

Present differences between platforms are not just mobile devices programming language. Each platform has specific features of the user interface.

In (Charland and LeRoux, 2011) the differences between native code development and web development for mobile devices are presented. Such differences in development between platforms are restricted to a single web application development is accessible to all platforms via a web browser and presented to the user.

3. Developing mobile web application

A web application is a system that runs on a web server that hosts a series of pages or documents which are linked and accessible to users through a web browser that is the web client. The architecture of a web application is shown in Figure 2.

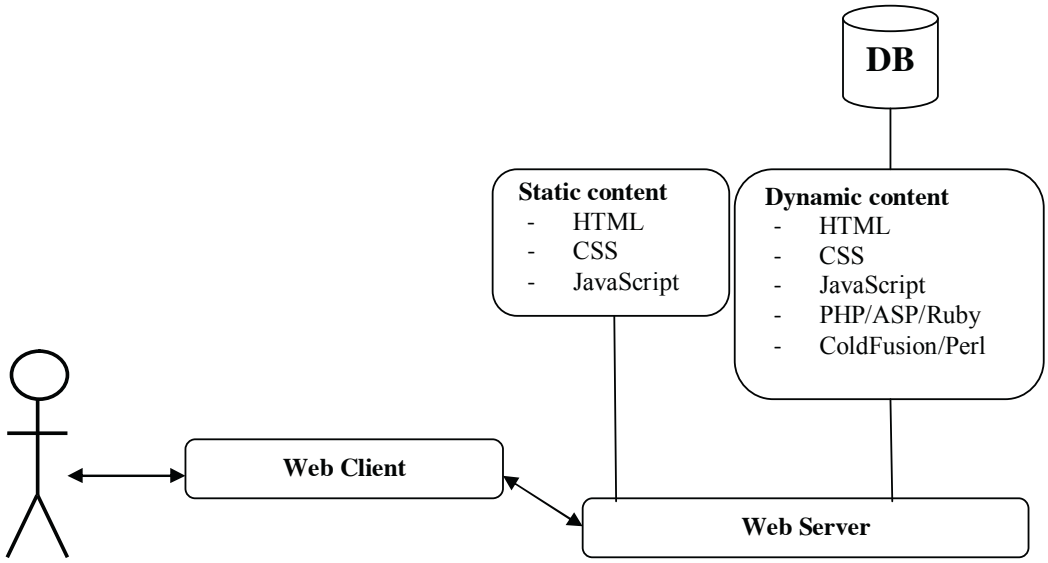

Fig. 2. Web application architecture

In (Griggs, Bridges et al., 2009) the mobile experience regarding the design of the web sites and way of presentation of the web content is presented. To test a standard site that will work in all computer browsers is more easy that test a site that must work in thousands of devices and hundreds of browsers on mobile so the develop and testing an mobile web site is more difficult. A list of recommendations of the design for mobile websites is realized:

Table 1. Recommendations for web mobile applications

Hierarchy	Split the information into task and labels
	Highlight the important content by positioning above the page
	User does not have to press more than 2-3 times to get the desired information
Links	Assign to each link in the page a number from the keyboard as shortcut
	If a link is to non-mobile site, the user should know that situation
	Possibility to call automatically a phone number which is written in the content
Navigation	Minimize scrolling on navigation pages
	Assign an icon to each navigation link
	Put most-used navigation sections on the top of the page
	Include basic navigation buttons at the top of every page
	Include basic navigation buttons at the bottom of the page, too
Footer information	Include link to full Website (Desktop version)
	Include link to an about and feedback page.
Page titles, navigation links, and URLs	The title and the links should not exceed 15 characters.
	Keep URLs short and easy to type
	Use only alphanumeric characters
Page Content	Highlighted the content of interest
	The important subjects are on the top of the page
	Balance pagination and scrolling.
Page Layout	Do not use frames or tables.
	Do not use pixel measures or absolute units.
	Do not rely on support of font-related styling.
	Do not rely on style sheets for content organization.
Forms	Use drop downs, radio buttons or checkboxes rather than text fields to minimize typing.
	Keep the number of key strokes to a minimum.
	Provide pre-selected default values where possible.
	Label all form controls appropriately and explicitly associate labels with form controls.
Images and Color	Design a vectorial logo that can work on multiple screen sizes.
	Keep images to a minimum size.
	Do not use graphics for spacing.
	An image should be no larger than 80% of the device's screen width.
Screen Sizes	Existence of two sites with different sizes for mobile and desktop

Source: (Griggs, Bridges et al., 2009)

Web mobile applications are being a very used like traditional web applications, even more due to omnipresence of the mobile devices.

4. Statistical analysis of accessing the mobile web application developed

For statistical analysis of accessing e-learning applications for mobile devices the application available to address zamfiroiu.ici.ro has been developed. The application is for teachers and students. Teachers have the possibility to upload homework and notes and students have the possibility to view the notes received and the issues to solve. In (Zamfiroiu and Vintila, 2013) application structure is presented and how the quality was ensured during web application development.

The application was developed with an automated way of gathering information about the activity on the site. For every action that happens on the platform automated is saved the information about the client, the hour when is realized and what operation is realized.

The application has been tested by third-year students from The Faculty of Economic Cybernetics, Statistics and Informatics from distance learning in 6 January 2013 – 8 February 2013 period.

To access the site a QR code has provided through which students had instant access to the platform without having to type the full URL.

Figure 3 presents the ratio of direct access by typing the URL and accessing via QR code.

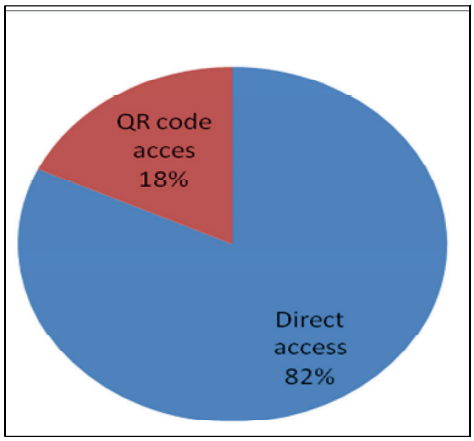

Fig. 3. Access way of mobile web application

Because the information was saved, have been saved the times when students were logged on the platform. Therefore an analysis can achieve peak hours for accessing the platform. Figure 4 shows the percentage of access per hours of the platform.

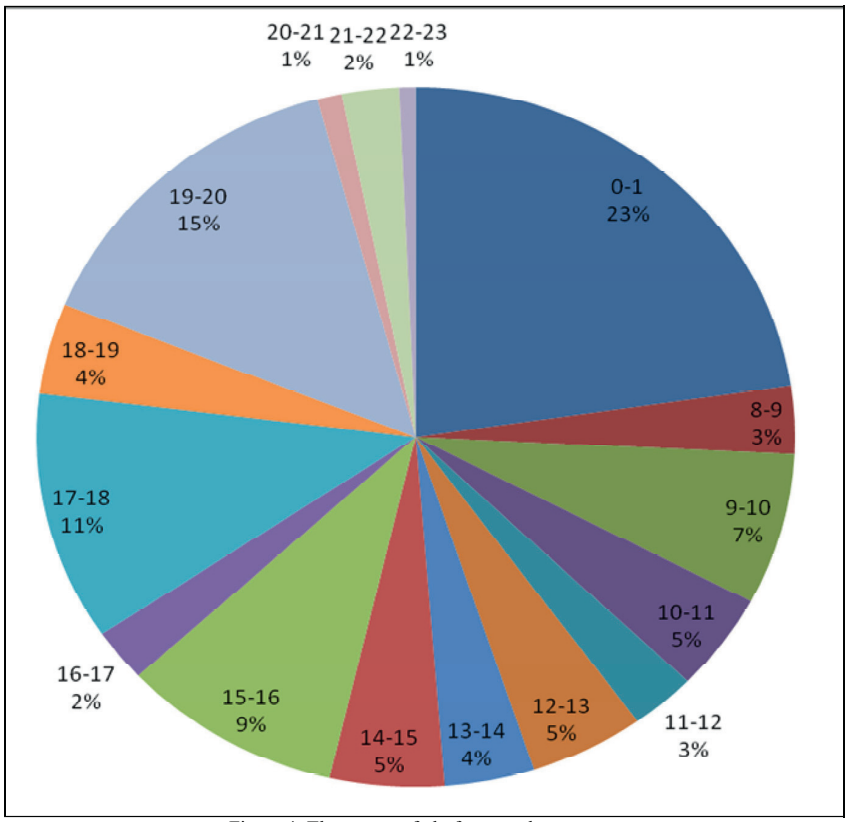

Figure 4. The access of platform per hours

Most visits took place at night from 00:00 to 01:00. The best time for maintenance on the platform according to current analysis is between 02:00 and 6:00 in the night, because between these hours the platform wasn't accessed.

Two other high-traffic periods are those between 19-20 and 17-18. During this period users during travel from work to home accesses the e-learning through mobile devices they have on them.

These periods of high-traffic are important for the platform administrator who has to manage the activities and the maintenance of the E-Learning platform.

It is considered the set of hour's pairs:

$$HS = \left\{ c = (a,b) \quad | \quad b = a+1; \quad a = \overline{0,23} \right\} \tag{1}$$

and the number of accesses set:

$$NAS = \left\{ na_0, na_1, ..., na_{23} \right\} \tag{2}$$

where:

nai - the number of accesses in period (i, i+1), a pair from HS.

It is determinate the function g():

$$g(c_i) = na_i \tag{3}$$

where:

$c_i \in HS$, is a period from hours set;

$na_i \in NAS$, the number of accesses in period c_i.

Using the relation (3) it is determinate the set of hors for maintenance, HMS, according to the formula:

$$HMS = \left\{ h_i \quad | \quad h_i \in HS; \quad g(h_i) = \min(NAS) \right\} \tag{4}$$

In this way the hours when is recommended to make the maintenance of the E-learning platform are determinate.

For this analysis next results are obtained:

$$\begin{aligned} HS = \{ \quad & (0-1), \quad (1-2), \quad (2-3), \quad (3-4), \quad (4-5), \quad (5-6), \\ & (6-7), \quad (7-8), \quad (8-9), \quad (9-10), \quad (10-11), \quad (11-12), \\ & (12-13), \quad (13-14), \quad (14-15), \quad (15-16), \quad (16-17), \quad (17-18), \\ & (18-19), \quad (19-20), \quad (20-21), \quad (21-22), \quad (22-23), \quad (23-24) \quad \} \end{aligned} \tag{5}$$

$$NAS = \{23, \ 0, \ 0, \ 0, \ 0, \ 0, \ 0, \ 0, \ 3, \ 7, \ 5, \ 3, \ 5, \ 4, \ 5, \ 9, \ 2, \ 11, \ 4, \ 15, \ 1, \ 2, \ 1, \ 0\} \tag{6}$$

$$HMS = \{(1-2), \ (2-3), \ (3-4), \ (4-5), \ (5-6), \ (6-7), \ (7-8), \ (23-24)\} \tag{7}$$

According to this analysis the period for maintenance is between 1:00 a clock in the night and 8:00 a clock in the morning.

5. Conclusions

Statistical analysis performed helps to improve the organization of Mobile E-Learning platforms. The results were obtained automatically through Mobile E-Learning platform developed for third-year students from The Faculty of Economic Cybernetics, Statistics and Informatics from distance learning.

The most common screen resolutions are determined. They are used in the development of mobile e-Learning platforms by adapting the content to the devices and the most used screen resolutions.

Based on the statistical analysis the optimal time for maintenance of the mobile E-Learning platform is determined.

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